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LAKE WISE

A Voice for Quiet Waters

The Oregon Lakes Association Newsletter

Fish Farming in Oregon Lakes?

Some California lakes have recently been getting special attention. A non-profit group centered in Fresno secured seed money and supplemented those funds with a series of fishing derbies in order to take on more ambitious projects. One of these involves placing net pens into lakes and stocking them with one pound trout. The fish are fed hatchery chow from November to May, when they are released into the lake, healthy and three times larger than when they entered the pen.

This is an interesting project on a number of levels. In addition to making trophy fish available, it requires the coordination and cooperation of several groups and organizations, it generates focused interest on local fisheries, and it stimulates recreation activity at the chosen lake. Lake marinas have been willing to provide dock space during their slack season and take on the daily chore of feeding the fish as part of their other routine duties. The trout come from area hatcheries selected by the California Department of Fish and Game. On delivery day, the non-profit convenes the manpower to bucket brigade the fish from the trucks into the pens. They also supply the pen materials, the manpower to assemble and put them in place, and the food to turn the trout into trophy status.

The pens are PVC pipe and hardwire cloth structures that measure 12 x 10 x 12 feet. Assembling the $1200 of materials needed for a pen seems to be a weekend adventure. Once constructed, they can be readily moved on boat trailers and towed with boats to get them to their working location. A stocking day at one installation transferred 4500 fish into 12 pens, which comes to 375 fish per pen, or 7 fish per cubic yard. An aquaculture publication cautions against stocking levels greater than 4.5 pounds of trout per cubic foot. Applying this upper limit guideline to 4 pound fish suggests 30 trout per cubic yard are manageable.

The organization behind this activity is Kokanee Power (www.kokaneepowor.org), an offshoot of another group that formed to lessen the impact of the CDFG decision to end funding for raising and stocking kokanee in 1998. Like their predecessor, Kokanee Power supports hatchery operations, encourages family fishing excursions, contributes to high school and college fisheries programs, offers fisheries scholarships, and seeks cooperative ventures with like-minded organizations. Their first net pen was put to work in 2003 and they are now approaching having two dozen in place. An Oregon chapter of Kokanee Power was organized this March. Most members are in the Rogue River area, but they report interest elsewhere as well.

Aquaculture is improving, but it is typically perceived as a commercial venture that has good potential but only modest returns to date. Feedlots either on land or at sea may not be the most wholesome places one would care to visit, but there have been no better ideas about how to keep the marketplace supplied with food for our population. Animals, whether fish, fowl, or livestock are inefficient feeders and produce lots of waste. Waste management then becomes a major issue because animals confined in high densities are more susceptible to health problems. Allowing wastes to fall to the lake bed through open screen pens is only a short term solution. Furthermore, lakes are the least likely place to attempt this sort of operation because they lack the current of

streams or the tidal surges of the ocean to provide a minimum of water circulation in the pens. But the Kokanee Power pens are not really aquaculture. There is no overriding concern about cost/benefit ratios to set pen stocking rates, and the pens are not even used for half of the year. Accounting for their end product is just dismissed. It could be argued that their end products are not tangible fish carcasses, but rather the intangible excitement of knowing there are some good sized, hungry trout in the lake. The experiment is underway to determine if these tangible/intangible pros and cons pencil out.

Restoring Fish Runs to the Upper Deschutes Basin

It is likely that a change is coming to the fisheries in Lake Billy Chinook and Lake Simtustus. Portland General Electric and the Confederated Tribes of Warm Springs, co-owners of the Round Butte/Pelton hydroelectric project on the Deschutes River, are betting $108 million that they can reestablish runs of spring Chinook salmon and summer steelhead past their dams there. The Project consists of three, stair-step dams with a cumulative capacity to produce 465 MW of power. It is located about three miles upstream of the bridge at Warm Springs, and backs up water on the Metolius and Crooked Rivers as well as the Deschutes. The money at stake is the cost of constructing a selective, underwater intake tower in Lake Billy Chinook, 700 feet upstream of the Round Butte Dam. To be successful, this structure must create a current strong enough to guide smolt migrating downstream into screens that will divert them to collection facilities so they can be moved below the dams. The intake, which is now under construction, will be able to draw up to 6000 cfs from either the warmer surface water, or cooler water at the base of the dam to supply the power plant's three generators. The selective use of the intake gates also provides a tool for managers seeking to optimize temperature conditions in the reservoir or the downstream receiving waters.

There were provisions for fish passage when Round Butte Dam was built is 1964, but it soon became obvious that they were not working. The dam is downstream of the confluence of the Metolius and Deschutes Rivers. As the rivers merge, the cooler, denser waters of the Metolius sink below those of the Deschutes, which actually move up the Metolius arm of the reservoir. Without a discernible current to direct them to the collection facility, migrating smolt were unable to continue their ocean bound journey. Furthermore, the pen stocks for the Round Butte powerhouse are at the base of the dam and so supplied the generators with a greater proportion of Metolius River water, cooling the lower Deschutes below the water temperatures common before the dam was built. The disruption of an established fish run required PGE to build a hatchery where 160,000 summer steelhead and 240,000 spring Chinook smolt were produced annually from fish captured during their upstream, spawning migration at the fish trap at the regulating dam downstream of Lake Simtustus. This hatchery went into operation in 1974 and will continue until the natural runs are re-established.

The plan to design and build a new intake structure came from the 2005 agreement of the Federal Energy Regulatory Commission to relicense the Round Butte/Pelton Project. The summer steelhead run drew special attention in these proceedings as these fish are listed as a threatened species. If the intake modification performs as planned, 226 miles along the Deschutes, Crooked, and Metolius Rivers will once again be available as spawning habitat. The kokanee now confined in Lake Billy Chinook may also resume their migratory habit as sockeye salmon. The ability to retain the cooler Metolius River water in Lake Billy Chinook should benefit resident bull trout there and discourage smallmouth bass. Passing warmer surface water on to Lake Simtustus will restore water temperatures there to their historical range. In anticipation that everything will work as planned, salmon and steelhead fry were placed in creeks upstream of Lake Billy Chinook last year and again this year. These hatchlings will be ready to test the intake tower current when it begins operation in 2009.

Extremes of Dissolved Oxygen Saturation

The "Dead Zone" that has been appearing annually off the coast of Oregon and Washington since 2002, calls attention to the importance of oxygenated water for both marine and aquatic life forms. Animals in water with low oxygen content must either escape or die of suffocation. There are no fish in these dead zones, and the bodies of animals with limited mobility litter their depths.

The Oregon dead zone is thought to be the result of changes in wind patterns. Wind moving over a water surface induces movement of the surface water in the same direction as the wind. A stationary object in the path of this movement will change its direction, either laterally or vertically. The downward movement of oxygenated surface water can displace deeper water, which can have lower oxygen but higher nutrient content. An upwelling of nutrient rich waters exposed to the light at shallow depths will bloom with plant life. The photosynthesis of these plants will oxygenate the water and stimulate an expansion of the food web. If oxygen levels are insufficient to support this productivity, then the decay of dead life forms falling through the water column will further deplete oxygen levels, creating a zone of water inhabitable to animals relying on oxygenated water.

Oxygenation of surface waters does occur at the air/water interface. Air is roughly 21% oxygen, which is equivalent to 210,000 parts per million, while cold water saturated with oxygen contains only about 12 ppm. The movement of oxygen across this steep gradient increases when wind driven turbulence increases the surface area at the air/water interface. The rate of the movement of oxygen from the air into the water is also affected by atmospheric pressure. This relationship is described by Henry's Law, which was stated by the English chemist William Henry before his death in 1836. The Law observes that the amount of a gas that dissolves in a liquid is proportional to the partial pressure of the gas over the liquid.

A Lake Profile in October

depth	temp.	dissolved oxygen	
m.	°C.	mg/L	% sat.
1	18.9	7.9	95
5	18.9	8	96
6	18.9	7.9	96
7	18.9	7.9	96
8	17.2	9.7	113
9	14.5	10.9	120
10	12.5	11.3	119
11	11.3	11.4	116
12	9	11.5	112
13	8.2	11.4	109
14	7.4	11.5	107
15	6.6	11.5	105
20	5.1	10.9	96
25	4.6	10.6	92
30	4.3	10.4	90
35	4.2	10.2	88
40	4	10.1	87
45	4	10	85
50	4	9.8	84
55	3.9	9.8	84
60	3.9	9.7	83
65	3.9	9.6	82
70	3.9	9.6	82
75	3.9	9.4	80

Oxygen saturation levels in water are based on the rate that oxygen molecules combine and detach from water molecules. An oxygen molecule consists of two bonded oxygen atoms that are non-polar because their outermost electrons are evenly distributed. A water molecule is polar because the outermost electrons of the bonded oxygen atom and two hydrogen atoms are not distributed evenly; they are clustered more around the oxygen atom. Electrons carry a negative electrical charge so their greater abundance around the oxygen atoms makes it slightly negative and the hydrogen atoms slightly positive. The electrical asymmetry of a water molecule will distort the electrical field of an oxygen molecule to create an attraction between these different molecules. Oxygen bound to water by this attraction is said to be dissolved. When the rate of bonding of oxygen and water molecules is equal to the rate that this weak attraction is broken, the water is oxygen saturated. Oxygen saturation levels decrease as water temperatures rise because the increased thermal energy in warmer water increases the stretching and breaking of the bond between water and oxygen molecules. Decreasing atmospheric pressure and increasing salinity are also factors that tend to decrease oxygen saturation. The partial pressure of oxygen in air decreases with increasing elevation and varies as weather

patterns affect barometric readings. The effect of salinity on dissolved oxygen is due to competition for binding sites and the disruption of electrical forces in water.

It is not uncommon to measure dissolved oxygen levels that are greater than 100% saturation, and levels greater than 200% do appear in peer reviewed reports. This anomaly is chiefly due to conditions in the water body under examination. Supersaturation is an unstable condition that can persist only if its causative factors are a continuing process. One of the most common causes of oxygen supersaturation is photosynthesis of aquatic plants. Other mechanisms that can produce this condition include the introduction of cool saturated water to warmer receiving water, as can occur when spilling deep water withdrawals from a reservoir; the entrainment of air bubbles at the base of a waterfall or spillway; or a rapid decrease in barometric pressure.

Dissolved oxygen measurements are most often reported as concentrations, for example 8 mg/L. These absolute values permit the ready judgment of whether sufficient oxygen is available for crucial thresholds, but it can also be useful to present dissolved oxygen data as per cent saturation, which are relative values. A concentration of 8 mg/L has somewhat different meanings if it represents 100% saturation at 27°C or 70% at 7°C. The lake profile above provides a comparison of these presentation formats. Neither is better than the other, and the situation will dictate which is more appropriate. It is apparent however that oxygen profiles are best considered with water temperature data, regardless of the format.

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Our Man in Chicago

Report from the 21st Annual National Conference on
Enhancing the States' Lake Management Programs
By Ben Johnson, OLA Director, Lake Oswego Corp. Water Quality Intern, MS candidate at PSU

On April 29th – May 2nd the US EPA, the North American Lake Management Society, and the Chicago Botanical Garden hosted their annual lake conference in Chicago, Illinois. The theme this year was "Building Partnerships for Improved Fisheries and Water Quality", and encouraged developing and nurturing partnerships between regulatory agencies, fisheries managers, and lake users. In excess of 150 people including fishing advocates, regional lake association representatives, scientists, and state officials attended.

The need for partnerships to effectively manage lake systems is rooted in what has been called the three legged stool of environmental management. The legs of this stool are: 1.) the best available science, 2.) economics, and 3.) socio-politics. Due to the multidisciplinary nature of the legs, successful management of lakes requires open lines of communication between scientists, economic planners, and politicians. Throughout the Conference, from Christopher Horton's (B.A.S.S. Conservation Director) keynote address to Richard Leopold's (Iowa DNR Director) discussion of the realignment of Iowa state water policy, the power and need for comprehensive partnerships was made clear.

The NALMS regional affiliate's meeting is a regular part of the Conference agenda and produced a lively exchange of ideas. Many affiliates expressed their desire to have a voice on the NALMS Board. This goal might best be achieved by increased affiliate participation in the NALMS online group and working towards the development of an affiliates committee. Once a committee is established, NALMS would be willing to make an affiliate seat available on their Board. Interest was also expressed in gaining NALMS' support for regional associations in states where federal Clean Water Act responsibilities aren't being upheld. NALMS responded

by saying that it was willing to go to bat for affiliates that felt unheard, but needs to establish working relationships and structures first. By the end of the meeting it was agreed that a national organization such as NALMS would be able to give regional affiliates more potency when addressing local issues.

This was the OLA poster's first trip to the Conference. It colorfully displays an outline of our mission and by the end of the three-day event; all of the available literature on OLA had made it into circulation. In the vein of non-profit promotions, a break out session was conducted which focused on the development of websites. Particular attention was given to ways that a website can be organized in order to garner increased participation and fundraising by non-profits. The OLA website has long been a valuable asset of the organization but still, ideas for improvement warrant serious consideration.

In addition to the call for partnerships, many other aspects of lake management were also covered. Special attention was given to fisheries management, increasing problems with aquatic invasive species, and "cultural eutrophication". All these issues are relevant in Oregon. With a changing climate and increasing development, the future of maintaining quality lakes and fisheries looks rocky. Jim Martin, former ODFW Chief of Fisheries and now at the Berkley Conservation Institute, ended the Conference with a call for all parties to rally for the protection of our nation's water resources. Although the tone was urgent, it was clear that the attendees all possessed the hope, will, and resolve to tackle these issues.

Roslyn Lake Passes into History

On May 5th, Portland General Electric crews closed the flume gates behind the Little Sandy River dam to begin the final drawdown of Roslyn Lake. By May 12th, just a few isolated pools remained. The Sandy Fire District had removed their tanker fill piping from the dike, and ospreys and bald eagles had transferred fishing rights to sandhill cranes and egrets. They, in turn, had teamed with raccoons to leave little on the lakebed but molted crayfish exoskeletons and the usual jetsam. Office trailers had been set up in the park and orange flagged stakes had appeared to mark lowland areas that were not to receive fill when the dikes were pushed in. The Portland Water Bureau had begun dismantling their conduit connections, and muddy footprints of the daring and their dogs marked the border of the drying lake bottom.

Former fishermen gazed at the exposed bottom contours to reconcile their memories of successful outings. The dominant feature of the lakebed was the steep pool at the lake outlet structure, which fed the generators on the bank of the Bull Run River, some 300 feet below. This pool drew water from channels paralleling the dike on both sides of the outlet. The channel from the east was short, but lined up with another channel section west of the Water Bureau spillway for unneeded Bull Run water. The channel west of the outlet structure curiously meandered through the sediment in much of the northwest part of the lake. The mechanics that cut this gouge are easier to explain than to predict. The lake bottom below the Little Sandy River flume outlet was indeed a delta, formed from the settling of Sandy River sediments.

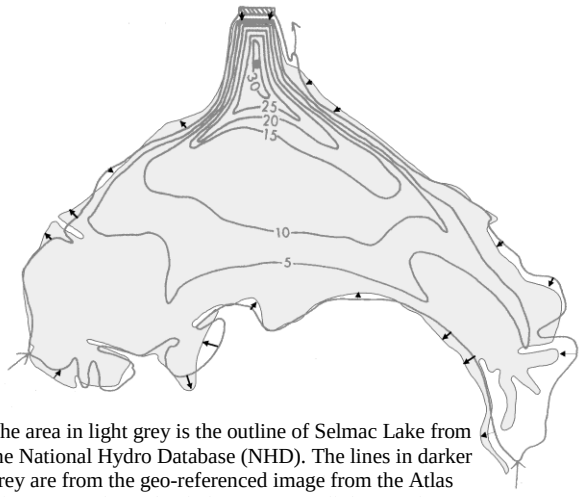
Demolition of the Marmot Dam on the Sandy River in the summer of 2007 made Roslyn Lake's last year one of unusual clarity, as it only received water of drinking water quality from the Little Sandy and Bull Run Rivers. Drinking water questions will keep Roslyn Lake in the news for a short time yet as the effect of its draining on the local water table becomes evident

Atlas of Oregon Lakes Update Update

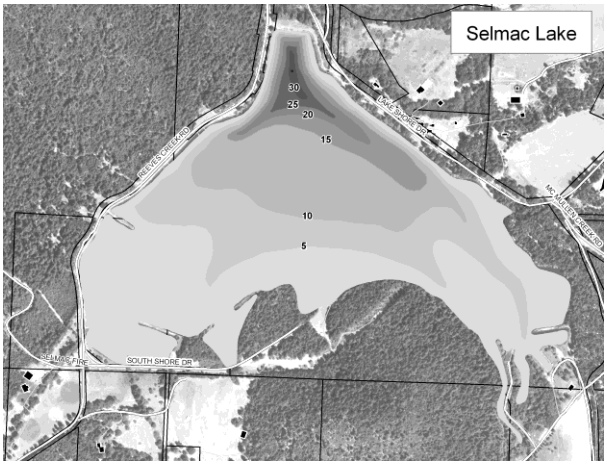
by Richard Lycan, Ph.D., PSU Professor Emeritus of Geography and Urban Studies, lycand@pdx.edu

Work is proceeding at Portland State University on updating of the 1985 Atlas of Oregon Lakes. The nearly 200 lake basins and bathymetric maps are being *geo-referenced* and *rubber sheeted* to place them in registration with contemporary GIS data layers and the colorful NAIP (National Agricultural Imagery Program) ortho-photo images (http://oregonexplorer.info/imagery/). We are initially completing this work for the five counties in Southwest Oregon (Coos, Curry, Douglas, Jackson, and Josephine) and expect to use these data do develop prototype lake atlas pages. Anyone with limnology expertise could assist our volunteer effort by updating the narratives in the 1985 Atlas for use in the SW Oregon prototype, for some or all of the 30 lakes in the five county area. I am overseeing this work and Roger Edwards and Mark Neuhaus are helping with the geo-referencing. Mark was one of the authors of the 1985 Atlas and recently retired from the Department of Geology and Mineral Industries, where he was a cartographer. We will show our results at the Oregon Lakes Association meeting at Wallowa Lake on September 13th. Copies of the scanned version (PDF) of the 1985 Atlas will be available at the OLA meeting

You might be interested in knowing what *geo-referencing* is about. We began by scanning the paper maps in the 1985 Atlas. Then we used our GIS software (Arc GIS by ESRI) to put the scanned image of the legacy map on the screen over a modern map. We picked common points in both images and let the software make the adjustment. The next step was to "rubber sheet" the image to the modern map's shore line, here the National Hydro Dataset or NHD (http://nhd.usgs.gov/), using adjustment ties, the dark arrows in the figure below. The rubber sheeting moves the shoreline, but also proportionally shifts the depth contours within the lake. The illustration below is for Selmac Lake, near Cave Junction. As you can see, the legacy image and modern map don't exactly fit. Lake shorelines are not static but change with water levels and by filling over time with sediments.



The area in light grey is the outline of Selmac Lake from the National Hydro Database (NHD). The lines in darker grey are from the geo-referenced image from the Atlas of Oregon Lakes. The dark arrows are "links" used to rubber-sheet the image to the NHD shoreline.



The map above shows the bathymetry for Selmac Lake after it was rubber sheeted to fit the NHD shoreline. The surrounding photo imagery is the 2005 NAIP color aerial imagery. Roads, structures, and property ownership have been added from the Josephine County GIS database.

We are following a similar process to bring the lake basins from an existence on paper into the world of digital mapping. There are two reasons for the geo-referencing of the lake basins. The first is that we must geo-reference legacy maps that we want to electronically *recycle* into a new lakes atlas. The second is that we plan

to generate tables describing the characteristics of the basins, including such themes as: land ownership, land use and land cover, precipitation, population, flow accumulation, soils, and slope. New GIS data layers continually become available which inform our understanding of the basin and its effects on its lake.

I mentioned our efforts to Milton Hill, the Framework Coordinator for the Oregon Geospatial Enterprise Office. We discussed the possibility of bringing lake basin and bathymetry GIS themes into the Framework (the Oregon effort to build key statewide GIS themes), providing them with official status. To put the issue on the table he suggested that I present some of these ideas to the Pacific Northwest Hydro Framework Steering Committee Meeting, the committee that coordinates Federal and State development of hydro databases for the Northwest. I made a presentation to the Committee on June 11th titled *Lakes – An Undervalued Oregon Resource* which described our efforts at updating the 1985 Atlas and the creation of lake basin and bathymetry layers. They seemed interested and supportive. Official recognition of our product, if this comes to pass, would come from the state as part of Oregon's GIS Framework efforts. It is important that we adhere to standards and protocols if our work is to be given official standing and to be considered for financial support.

Two other topics came up at the meeting relating to lakes. There was discussion of subsuming the USGS Geographic Names Information System (GNIS) efforts on water features into the National Hydro Database. Perhaps some of the work that Roger has done on cataloging of lakes in Oregon could contribute to this effort. Lake names are especially important since lakes usually are known by name, whereas a small tributary in the upper reaches of the Nehalem may not have a name, but it may suffice to know that it contributes flow to the Nehalem. Bob Harmon, the Oregon Water Resources Division representative on the Framework Committee, mentioned the old and USGS seven volume *Lakes of Oregon* series, long out of print, and expressed interest in seeing it scanned and made available on line.

Dolly Varden, *The Raven*, and a Fish

The Raven, which did come a tapping, tapping on the chamber door of Edgar Allan Poe, may also have intruded in the dreams of Charles Dickens. Dickens mentioned such an encounter in his novel, *Barnaby Rudge*, published in 1841, four years prior to Poe's poem. *Barnaby Rudge* is a historical novel about the No-Popery, Gordon Riots that swept through London for a week in 1780. The raven in this story is a pet named Grip that belongs to the title character. In chapter five, Grip is observed "knocking gently at the shutter". In the review of the novel that Poe wrote for Graham's Magazine, he opined that the raven could have been given a larger role in the work, suggesting that Grip's role had made an impression. The village locksmith in this tale was Gabriel Varden, the husband of Martha, and the father of Dolly. Dolly was a fetching, flirtatious girl who enjoyed the attentions of Joe Willet, the son of the innkeeper. She also had to endure the leering Hugh, the Maypole Inn's handyman. Like Grip, Dolly made a favorable impression on readers and she was recognized in song and with a calico dress that bore her name, which was fashionable in the era after the Civil War. The dress featured a festive red skirt and a gray-green, frock like mantle adorned with small red blossoms.

Elda McCloud had a Dolly Varden dress when she was shown a bull trout by some fisherman staying at her uncle's lodge at Upper Soda Springs on the Sacramento River. She noted the fish was prettier than its name and suggested Dolly Varden to celebrate the fish's red spots. This name is recognized in an 1874 report of the US Fisheries Commission and came to be applied to all such colorful trout in the northwest area of North America.

LAKE WISE
The Oregon Lakes Association
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OLA Mission: The Oregon Lakes Association, a non-profit organization founded in 1990, promotes understanding, protection, and thoughtful management of lake and watershed ecosystems in Oregon. For additional information on OLA, write to the address above, or visit our website.

OLA welcomes submissions of material that furthers our goals of education and thoughtful lake management in Oregon, and is grateful for the corporate support that helps sustain the organization. Corporate members are offered a one-time opportunity to describe their product or service to Lake Wise readers. These descriptions are not endorsements, and opinions appearing in Lake Wise are not OLA policy statements.

Visit our website: www.oregonlakes.org

Without mentioning the confusion that developed between the Dolly Varden and the Arctic char, *Salvelinus alpinus*, it was demonstrated in 1978 that there were two distinct species of fish that were known by this name. The bull trout had been described in 1858 on the Puyallup River as *Salvelinus confluentes.* The other fish had been described in 1792 on the Kamchatka peninsula of Russia as *Salvelinus malmo.* It had not been christened with a common name, so it inherited the one Elda McCloud had bestowed on its close relative.

Structure of September Conference at Wallowa Lake is Coming Together

There are many details in planning a conference so it is gratifying when completed tasks begin to take the shape of the original idea. OLA's Wallowa Lake Conference will have a little different look from several perspectives. Wallowa Lake is in a part of Oregon that OLA has long admired, but never visited. Our arrangements with the Wallowa Lake Camp and Retreat Center will provide communal dining on the Saturday of the Conference to maximize the time attendees can get to know one another. The Retreat Center also offers accommodations that can help recoup some of the cost of getting there. Do consider carpooling. The agenda will hopefully explore the experiences from Idaho in dealing with challenges to lake management that come up a little to the east. The problems may sound familiar but there might be some innovative solutions. There will be an in depth discussion on man's relationship to the land. Representatives from the Yakima, Nez Perce, and Warm Springs Tribes will describe their bonds with nature at a site that is universally held in some awe. The disputes over land-use that have played out around Wallowa Lake will serve as examples of how varied viewpoints can be resolved. The Enterprise office of the ODFW will be on hand to share their understanding of the lake and other presentations will update on-going lake issues in Oregon. Electronic Data Solutions and In-Situ have already signed on to display their instruments. Do join us there on September 12-14. An informal gathering on Friday evening will present a chance to exchange thoughts about OLA, if you're not too busy with the other activities at the lake's south end. Watch the OLA website for registration updates.